

| ID | Risk | Category | Consequence | Likelihood | Likelihood comments | Consequence comments | Risk | Mitigation | Mitigated Likelihood |
|----|--|-------------------|-------------|------------|---|---|------|---|----------------------|
| | | | | | | | | | Med |
| 1 | Achievement of adequate lifetime requires evacuation. (MicroBooNE and/or LAPD were not successful) | Argon Purity | 3 | 1 | Consensus likelihood is consistent | | Med | Keep modular cryostat as an option | 0 |
| 2 | Cannot achieve required drift length | Argon Purity | 3 | 1 | e.g. feedthrough leaks, cable outgassing, microscopic cryostat | | Med | Develop QA procedures for leak checking (warm & cold) and materials qualification | 0 |
| 3 | Argon purity immediately following filling is poor requiring several volume recirculations before operations can begin | Argon Purity | 1 | 3 | We deferred to Flavio's experience on this issue (high likelihood) but the Long lifetime has been demonstrated, but not long drift distance | | Med | | 3 |
| 4 | Increasing the drift distance is a low impact method of reducing the cost of LAr20, however drift distances >2.5m may not have been demonstrated | Argon Purity | 2 | 1 | "Hot electrons" at 87K damage the cryogenic ASICs over the lifetime of the detector with a loss of >50% of the detector channels | There is already in place an R&D plan to address this risk | Low | Perform stress test on ~5% of the LAr20 channel count | 1 |
| 5 | Single point failure in electronics requires emptying cryostat to repair | Electronics | 3 | 1 | Ref GEOSTOCK risk assessment < 110k years | Revised the risk description | Med | Med | 0 |
| 6 | The membrane cryostat develops a major leak during operation. | Membrane cryostat | 3 | 0 | Consensus likelihood is consistent | Integrated Plan Review comment | | | |
| 7 | Extrapolation from LNG experience/design to LAr is invalid or not understood adequately | Membrane cryostat | 3 | 1 | Ref GEOSTOCK risk assessment < 110k years | Integrated Plan Review comment | Med | Engineering analysis will mitigate this | 0 |
| 8 | Vessel ruptures due to ground water pressure | Cavern | 3 | | | Integrated Plan Review comment | | | |
| 9 | Rock freezing causes fracture of supporting rock | Cavern | 3 | | | Integrated Plan Review comment | | | |
| 10 | Rock bolt failure causes rupture of cryostat | Cavern | 3 | | | Integrated Plan Review comment | | | |
| 11 | Cryostat ruptures due to falling rock | Cavern | 3 | | | Integrated Plan Review comment | | | |
| 12 | Suppliers are unable to deliver the needed quantities of cryogens on the schedule needed for filling | Management | 2 | 1 | Argon availability is more of an issue in Europe than in the U.S. Stephen: 50kton | Low | | | 1 |
| 13 | Critical components have a single supplier - procurement & operations | Management | 2 | 0 | The CMOS ASIC's are the only critical component that may | Membrane cryostat is the only candidate for single supplier | Low | There is already an R&D plan in place | 1 |
| 14 | There are insufficient technical resources to conduct the planned and proposed R&D | Management | 2 | 3 | | | High | Increase FNAL resources | 2 |